Corrosion behavior of Co–P coatings electrodeposited from chloride bath

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Co–P coatings are electrodeposited from cobalt chloride baths with various sodium hypophosphite concentrations employing direct current (DC) and pulse current (PC) methods. X-ray diffraction (XRD) studies reveal the fcc to hcp transformation of cobalt and also the crystalline to amorphous structure with increasing phosphorous content in the deposited coatings. Electrochemical corrosion behavior of these coatings studied in non-deaerated 3.5% NaCl solutions at room temperature by potentiodynamic polarization and electrochemical impedance spectroscopy (EIS) shows an increase in corrosion resistance with increase in phosphorous in both DC and PC plated coatings. Higher polarization resistance (R_p) and lower corrosion current density (i_{corr}) has been observed for DC and PC coatings obtained from baths containing 10 g L^{-1} NaH_2PO_2 while the overall corrosion resistance is better for the PC coatings. Compositional analysis by energy dispersive X-ray spectroscopy (EDXS) displays a significant increase in P content after corrosion in low P coatings showing lower corrosion resistance when compared to high P coatings . Comparison of field emission scanning electron microscopy (FESEM) images before and after corrosion shows that the DC plated coatings are more affected than the PC plated coatings. Electronic structure obtained from X-ray photoelectron spectroscopy (XPS) shows higher amount of oxidized cobalt in PC electrodeposited coatings while mainly metallic Co species is found in DC plated coatings. This study demonstrates that the overall corrosion rate is lower for the PC deposited coatings than the DC deposited coatings owing to higher P content, amorphous nature, smooth morphology and higher metal oxide content in the deposits.

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